Road Traffic Injuries: Hidden Epidemic in Less Developed Countries

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Road traffic injuries (RTIs) are a leading cause of morbidity, disability and mortality in less developed countries. Globally in 2002, 1.2 million deaths resulted from RTIs, and about 10 times that were injured. RTIs are often preventable, and the technology and knowledge to achieve success in this area exist. In spite of this, it is projected that given the current trend and without adequate intervention, RTIs will rank third of all major causes of morbidity and mortality globally by 2020. Although >85% of the global deaths and injuries from road traffic crashes occur in less developed countries, traffic safety attracts little public health attention in these nations, due in part to a plethora of other equally important problems, including infectious diseases. Unfortunately, the public health and economic impact of traffic-related injuries and disabilities can be incalculable in these countries, owing to their poorly developed trauma care systems and nonexistent social welfare infrastructures to accommodate the needs of the injured and the disabled. In this paper, we highlight the problem posed to public health in less developed countries by RTIs and examine contributing factors. To engender debate and action to address the problem, we reviewed interventions that have proven effective in industrialized nations and discussed potential barriers to their replication in less developed countries.

Key words: road traffic injuries ■ traffic safety, accidents ■ unintentional injuries ■ developing countries ■ disabilities

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INTRODUCTION

The World Health Organization (WHO) produced its first authoritative report on the problem of road traffic injuries (RTIs) more than 40 years ago.[1] In 1974, Resolution WHA27.59 was passed by the World Health Assembly, declaring RTIs "a major public health issue" and calling on member states to address it.[1] Nevertheless, implementation of programs has been slow or nonexistent, and RTIs continue to exact an enormous social and economic toll on many poor countries around the world.[2] In contrast to the consistent declines seen in high-income countries (HICs), many developing nations have witnessed dramatic increases in the number of road traffic deaths.[3] As a result, there has been renewed interest in the international health community to more strongly emphasize the public health importance of road safety. For example, the WHO recently formed the Department of Injuries and Violence Prevention, and the World Bank formed an interdisciplinary taskforce to ensure road safety issues are jointly addressed by transport and public health departments and professionals. In addition, the 2004 World Health Day was dedicated to road safety to reflect the huge importance of this problem.[1]

William Haddon, Jr. pioneered road safety research when he combined the host–agent–environment triad with the concepts of primary, secondary and tertiary prevention to create the Haddon Matrix (Table 1).[4] This matrix provides a framework for understanding the etiology of injuries and allows for the identification of potential interventions at each step in the injury process.[4] The resulting systems approach taken by developed countries has resulted in decreased rates of motor vehicle injuries and fatalities by dispelling the notion that road traffic crashes are random and unpredictable events and by involving professionals from multiple sectors (Table 2).[1,5] However, this approach has been a challenge for less developed countries to adopt as it requires considerable resources and infrastructure to implement.[1] Nonetheless, there are available measures that can be taken to reduce the concomitant human

suffering and economic impact caused by RTIs.

This paper discusses the current state of RTIs in less developed countries, including the magnitude and key determinants of the problem, contributing factors and selected prevention interventions that have proven effective in HICs and are potentially transferable to other settings. Data presented are primarily from observational and descriptive studies as randomized controlled trials or controlled before-after studies conducted in less developed countries on this subject are rare. When possible, evidence for intervention effectiveness is presented from systematic reviews of studies performed in HICs. WHO African and southeast Asia regions are emphasized since these are among the worst affected.[1,2] Less developed countries encompass those of both low- and middle-income levels, as defined by the World Bank. Low-income countries have a gross national income (GNI) per capita of $765 or less, while middle-income countries are between $766 and $9,385.[6]

MAGNITUDE OF THE PROBLEM

RTIs are a cause of public health concern in virtually every country of the world.[7] However, the distribution of mortality and morbidity is highly uneven, with developing countries incurring 85% of all deaths due to traffic crashes, 90% of lost disability-adjusted life years (DALYs) and 96% of all child deaths due to RTIs.[8] Estimates of deaths resulting from RTIs vary as a result of underreporting and a lack of reliable data due to incomplete records.[9] According to WHO estimates, approximately 1.2 million people were killed in traffic crashes in 2002.[1] An additional 20–50 million persons are injured or disabled each year.[8] Most of these statistics are accounted for by "vulnerable road users," including pedestrians, bicyclists, motorcyclists and riders of scooters or mopeds, mostly in less developed countries.[9]

In 1998, RTIs ranked ninth for DALYs lost globally.[8] In 2002, they were the second leading cause of death for children aged 5–14 years and young adults aged 15–29 years, and the third leading cause of death for adults aged 30–44 years.[1] It is projected that if current trends continue and new initiatives are not instituted, by 2020, RTIs will rank third for DALYs lost globally, and road traffic deaths in developing countries could increase by up to 80%.[1,8]

RTIs place enormous economic strain at the national, local and individual levels. Those most often affected by RTIs are young adults aged 15–44, who account for 48–78% of all traffic-related fatalities.[9] Males are consistently more likely to be injured or killed, thus increasing the number of economically disadvantaged widows and orphans.[8,9] Indeed, removal of the breadwinner, funeral costs, hospitalization fees or extended medical care for severe injuries can push a family into poverty.[9] Direct economic costs of global traffic crashes are estimated at $518 billion.[1] For developing countries, the costs are estimated at $65 billion, more than the total amount of all foreign aid donated.[9] In reality, these costs are likely to be considerably higher, especially when indirect and social costs are factored into the estimates. Direct costs include hospitalization fees, long-term medical care for the injured and loss of productivity. The average annual cost to the society of road traffic crashes ranges from 0.3% of the GNP in Vietnam to nearly 5% in Malawi and South Africa.[8]

KEY DETERMINANTS OF RTIS IN DEVELOPING COUNTRIES

Numerous factors play a significant role in traffic crashes and resulting injuries.[8] Some involve human behavior while others are system-related. Risk factors for the majority of RTIs around the world are the same, although they may differ in magnitude depending on

Table 1. The Haddon matrix applied to a road traffic crash

	Factors			
			Environment	
Phases	**Human**	**Vehicle**	**Physical**	**Social**
Preevent	Attitudes Knowledge Use of alcohol Driver experience	Vehicle condition Speed	Roadway design Traffic calming Pedestrian facilities	Traffic laws Cultural norms
Event	Use of seat belts Wearing fastened helmet	Seat belts Helmets	Shoulders, medians Guardrails	Helmet and seat belt laws
Postevent	First aid Medical treatment	Fire risk	Availability of trauma care equipment Traffic congestion	Standards of trauma care in hospitals

the region. Some of the major factors are the increased number of motor vehicles, speed, alcohol and mix of road users. These are discussed in detail below.

Increased Number of Motor Vehicles

A primary reason for the increase in fatalities and injuries from traffic crashes in poor countries is simply the rising number of motor vehicles.[2] Economic growth is associated with expanded mobility and demand for transportation services.[1] India, China and Vietnam, whose economies grew during the past 10–15 years, have seen rapid increases in their number of motor vehicles.[1] In India, four-wheeled motor vehicles have increased by 23% in only three years and could number 267 million by 2050.[1,2] China has seen a fourfold increase in vehicles since 1990 to >55 million.[1] In Vietnam, from 1992 to 2001, the number of motorcycles increased from less than 2 million to >8 million.[10] In addition, in just one year, the number of motor vehicles in Vietnam increased by 14%, while deaths and injuries rose by 31% and 16%, respectively.[2]

Speed

Speed is a crucial factor in many road traffic crashes and influences both crash probability and severity of injury.[11] As a general rule, the greater the speed, the more likely a crash will occur and the more likely severe injuries will be sustained.[11] In Ghana, speed alone was responsible for half of all traffic crashes between 1998 and 2000 and contributed to 44% of all police-reported crashes in Kenya.[11,12] A study in Kuwait attributed speed to be the primary cause for almost 92% of traffic crashes in the sample.[13]

Commercial vehicles—taxis, trucks, buses and minibuses—are disproportionately involved in traffic crashes in many low-income countries and inflict substantial morbidity and mortality.[12,14,15] Pressure to adhere to strict timetables often causes commercial drivers to exceed posted speed limits.[1] Speed regulators on commercial vehicles are often nonfunctional, nonexistent or intentionally disabled.[1] There is frequently an increased reliance on public transport in less developed countries. Ideally, this would be a positive phenomenon given the need to reduce traffic congestion and emissions. However, public transportation systems are not well developed in many resource-poor countries, thus allowing informal and unregulated fare-based systems to proliferate.[9,14] These systems, such as the matatus in Kenya, often consist of hazardously decrepit vehicles that are overloaded with passengers.[9] Intense competition for fares results in aggressive driving and over-speeding.[9]

Alcohol

Although alcohol is a known risk factor for traffic crashes, reliable data on the prevalence of driving under the influence of alcohol in developing countries are sparse. In Kenya, a survey of hospitalized patients revealed that of those being treated for traffic-related injuries, 40% of drivers and 20% of pedestrians reported being under the influence of alcohol at the time of the crash.[12] A study in New Delhi revealed that one-third of hospitalized motorized-two-wheeler riders admitted to drinking alcohol and driving.[1] Alcohol poses a huge threat to road users in South Africa.[16] Data from the National Injury Mortality Surveillance System shows that of all fatal transport-related cases tested in 2001, >50% had elevated blood alcohol content (BAC) and out of those, 91% exceeded the legal limit of 0.05 g/dl.[16] Over 62% of pedestrian fatalities had an elevated BAC and almost 25% had BAC of ≥0.25 g/dl, more than five times the legal limit.[16] In addition, >46% of drivers killed had BAC of ≥0.05g/dl.[16]

Mix of Road Users

Most developing countries have a blend of road users that is very different from that of industrialized nations. This mix varies depending on the region but typically consists of pedestrians, push carts, bicycles, mopeds/scooters/motorcycles, trucks, minibuses, buses and cars.[1] Danger arises from this mixture of slow-moving, nonmotorized users and fast-moving, motorized users sharing the same road space.[9]

Urban Versus Rural Differentials

The group of road users most often injured varies by region and geographic locale. In Asia, riders of two-wheeled vehicles and pedestrians are most commonly injured.[8] Motorcycles and bicycles had the highest rates of injuries in 2001 for both urban and rural regions in Vietnam.[10] Data from the Vietnamese Ministry of Transportation also indicate that urban traffic crashes are more frequent but that rural crashes are generally more severe.[10] In India, these same road users account for 70–80% of all deaths due to RTIs, while occupants of cars account for only 5%.[17] Africa sees most injuries and deaths being sustained by pedestrians in urban crashes and users of public transportation systems in rural crashes.[12] In contrast to Vietnam, 60% of all injury-producing crashes in Kenya occur on rural intercity highways, but only 40% occur in urban regions.[12] Due to crowded public transport vehicles being involved in rural crashes, the number of casualties per motor vehicle collision is greater on rural than urban roads.[12] Studies in Kenya show that pedestrians as a whole are the most vulnerable of all road users, and this group experiences the greatest number of injuries and deaths from traffic crashes.[12] Pedestrians in urban areas accounted for >70% of the total annual deaths due to road traffic crashes in 1998.[12]

In addition, a recent survey at Kenyatta National Hospital in Nairobi reported that pedestrians accounted for 65% of patients admitted for traffic-related injuries.[12] Pedestrians in urban areas are also the most likely to be injured in Latin America and the Caribbean.[8] In Colombia, traffic crashes are almost entirely an urban phenomenon, with only 10% of crashes occurring on rural highways.[18] As a result, pedestrians made up nearly 68% of victims from traffic crashes in Bogotá in 2000.[18]

CONTRIBUTING FACTORS

Poverty

There are a number of indirect factors, including socioeconomic factors, that contribute to and worsen RTIs in developing countries. Whereas walking and use of public transportation systems provide benefits to health and the environment in industrialized nations, these modes of transport place the poor at risk of RTIs in developing countries owing to the lack of safe pèdestrian lanes and inadequately regulated mass transit systems. Using level of education as an indicator of socioeconomic status in Kenya, it was found that 27% of people with no schooling relied on walking and 55% used public transportation, mostly matatus.[9] In contrast, 81% of those educated beyond secondary school rode in private cars, none walked, and only 19% used public transportation.[9] The poor are also less able to pay for medical treatment after being injured because the introduction of user fees at public health facilities has eliminated the free health-care that was formerly available.[2]

Inadequate Surveillance Systems

Many countries have some sort of system to collect data on road traffic crashes, usually from hospital records or police reports.[10,12] However, underreporting is a major problem, even in developed countries with good reporting systems.[1,9,19] Minor injuries are most likely to be underreported.[19] People may not seek medical treatment for such injuries or may be unable to pay for services and so are not captured by hospital records.[9,20] This is more likely to be true for rural than urban areas. In rural areas of Ghana, for example, patients that sustained severe injuries were less likely to seek hospital treatment than patients in urban areas due to an inability to pay for care.[2] Police and/or hospitals might not record injuries or fail to share information, resulting in discrepancies between sources.[1,20] Road traffic crashes that occur in rural areas frequently go unreported due to the lack of police presence.[20] Furthermore, the quality of the data is often questionable and makes international comparisons difficult.[1] Data may be incomplete or interpreted differently, reporting systems differ, and definitions of an RTI or death are not standardized.[1,9] Even when data are collected, they are rarely used as a basis for developing and evaluating policy or interventions.[8] Reliable and accurate data on the magnitude, characteristics and consequences of road traffic crashes are desperately needed in order to firmly establish RTIs as a public health priority and to create policy guidelines and interventions.[1] Without this data, policy makers will continue to fail to design appropriate policy responses to this public health challenge.[9]

Inadequate Trauma Care Systems

Inadequate public health infrastructure means many victims of traffic-related injuries die or are disabled from not receiving prompt trauma care.[2,21] In many developing countries, formal emergency medical services are nonexistent or are inaccessible to a majority of the population where they exist.[21] Much of sub-Saharan Africa and southern Asia do not have even rudimentary ambulance services in rural and most urban areas.[21] Surviving traffic crash victims are often transported to a hospital by bystanders, relatives, commercial vehicles or the police.[21] In Kenya, only 2.9% of crash victims are transported to a hospital by an ambulance.[1] Likewise, hospitals themselves are largely unprepared to treat trauma victims, who require special equipment and specialized medical care. A study of 11 rural hospitals located along busy roads that received high numbers of RTI victims in Ghana revealed that they were staffed by general practitioners with no training in trauma care.[21] In these same hospitals, none had chest tubes, which are inexpensive and vital for the treatment of life-threatening chest injuries, and only four had the necessary equipment to maintain an open, breathing airway.[21] In

Table 2. The systems approach to road safety

- A science-based approach to injury pioneered by William Haddon, Jr
- Haddon Matrix combines injury event time sequence and epidemiologic triad
- Allows for identification of primary factors that contribute to traffic crashes and possible interventions to prevent crashes or mitigate severity of crash outcomes
- Can be used to identify problems, formulate strategies, set targets and monitor performance
- Requires multisector cooperation and institutional capacity
- Is crucial for reducing road traffic injuries and fatalities

Kenya, only 40% of public, private and mission hospitals were well prepared to treat trauma patients, and almost none of the standard treatment items for managing severe injuries were found in government health facilities.[2] While lack of supplies is problematic, so too is poor utilization of such equipment when it is available. A review of >2,000 trauma admissions in an urban hospital in Ghana showed low utilization of blood transfusion and chest tubes.[21] Thus, inadequate trauma care is not unique to rural environments that lack ambulance services, as even well-stocked urban hospitals have much room for improvement in treating trauma victims.

INTERVENTIONS

In this section, we discuss interventions that have been proven effective in reducing RTI morbidity and mortality in HICs (Table 3) and examine their potential applicability to developing countries. Current interventions, barriers to implementation, intervention effectiveness and good practice examples in some developing countries are also highlighted to demonstrate what can be achieved even in situations of limited resources.

Motor Vehicle Occupant Protection

It is well established that seat belts decrease death and severe injury for motor vehicle occupants.[1,7,13,22-25] Studies conducted in the 1980s estimated that they reduce motor vehicle fatalities by 50% and severe injuries by 55%.[22,23] More recent studies have shown even greater reductions.[24,25] Seat belt use is mandated in many industrialized nations, but usage is low in most developing countries as many vehicles may not have functional belts.[23] It is estimated that less than half of automobiles in developing countries are outfitted with functional seat belts.[23] In addition, the lack of enforcement of existing seat belt laws contributes to the low usage.[22] However, seat belts are a feasible intervention for developing countries to adopt, providing several strategies accompany the implementation. Given that only half the vehicles in developing countries have functional belts, it is unrealistic to mandate usage.

One measure that governments could take is to ban the importation of vehicles without functional belts.[22] This would prevent from entering the country unsafe vehicles that would subsequently place occupants at risk. Another measure could be to require public transport vehicles to have seat belts installed, as is currently done with matatus in Kenya.[26] Such measures have the potential to improve public transportation safety by requiring each passenger to have their own seat, thus reducing passenger overloading.

Two-Wheeler Riders

Helmets are a primary intervention with proven effectiveness in reducing the risk of head injury. A Cochrane systematic review revealed that motorcycle helmets reduced the risk of head injury by 72%.[27] Helmets also appeared to reduce the risk of mortality, although an overall estimate of effect was not calculated.[27] Studies in Taiwan, Indonesia and Malaysia have attributed reductions in deaths to their use.[1,22,28,29] Taiwan saw a decrease in motorcycle fatalities and nonfatal injuries of 14% and 31%, respectively, following the passage of a mandatory motorcycle helmet law in 1997.[28] Nonfatal head injuries also fell by 44%.[28] Helmet legislation passed since 1973 in Malaysia is estimated to have contributed to a reduction in motorcycle fatalities by 30%.[1] Mandating helmet use by motorcycle riders is a highly transferable and feasible intervention for poor countries to adopt, since people who are able to buy a motorcycle should be able to afford a helmet.[22]

Standard helmets provide full head coverage and have a thick energy-absorbing lining, while nonstandard helmets cover a small amount of the head and have a thinner lining made from less absorbent material.[30] Few studies have investigated the differences between helmet types and injury outcomes. One study found that 33% of motorcycle riders wearing nonstandard helmets were killed and 75% sustained head injuries, while 13.6% of riders wearing standard helmets were killed and 30.7% had head injuries.[30] It is crucial that helmets be approved and worn properly for them to be effective. An observational study in Indonesia revealed that 45% of motorcycle drivers and 87% of passengers wore them with the chin strap unfastened, providing little protection in the event of a crash.[29]

Strategies to increase motorcycle helmet use would be to encourage or even require the purchase of an approved helmet when purchasing the motorcycle.[19] The importation of standard helmets that meet safety requirements, education campaigns on the importance of proper use and the enforcement of usage laws have the potential to reduce injuries and deaths from motorcycle crashes.[22,23]

Likewise, bicycle helmets have been shown to reduce the risk of head and brain injuries by 63–88%, but current usage is extremely low worldwide.[31] A study in Wuhan, China showed that none of the patients admitted for bicycle-related crashes had been wearing a helmet.[22] However, mandatory purchase and use of an approved helmet is unrealistic in many developing countries because bicycles are the cheapest form of transportation used primarily by the poor.[23] Strategies to promote their use could include government subsidy on helmet purchase, resources permitting and bicycle safety campaigns

to raise awareness of the importance of helmet use and foster safe riding habits.[23]

Pedestrians

The physical separation of pedestrians from traffic has been shown to reduce pedestrian injuries and deaths.[23] Despite this, sidewalks are primarily limited to urban areas, even in developed countries, leaving semiurban and rural inhabitants to walk along roadways.[22] Urban sidewalks may be crowded with vendors, in disrepair or simply not used.[35] In Karachi, Pakistan, it was observed that encroachments on sidewalks were a prime cause of pedestrians stepping onto the road.[35] Predictive models based on traffic data gathered in Addis Ababa, Ethiopia, indicate that wider sidewalks result in increased pedestrian safety.[36] Furthermore, a raised curb on the road edge reduced pedestrian accidents by 46% on undivided roads.[36] Sidewalks are feasible for developing countries because they are inexpensive but must be accompa-

Table 3. Interventions with proven effectiveness in reducing road traffic injuries and fatalities in HICs

Author/Year Country	Objectives	Study Design
Rivara et al, 2000 (United States)[24]	To determine the effectiveness of automatic shoulder belt systems in reducing risk of injury and death among front-seat passenger vehicle occupants	• Descriptive • Data collected from 1993–1996, National Highway Traffic Safety Administration Crashworthiness Data System
Cummings et al, 2003 (United States)[25]	To estimate the relative risk of death among belted and unbelted front-seat occupants	• Matched-pair cohort • Data collected from 1986–1998, Fatality Analysis Reporting System
Norvell et al, 2002 (United States)[32]	To estimate the association between death and helmet use	• Matched-pair cohort • Data collected from 1980–1998, Fatality Analysis Reporting System
Rowland et al, 1996 (United States)[33]	To compare incidence, type, severity and costs of crash-related injuries resulting in hospitalization or death for helmeted and unhelmeted motorcycle riders	• Retrospective cohort • Data collected from Washington State patrol records
Thompson et al, 1996 (United States)[34]	To examine the effectiveness of bicycle helmets in four age groups, in crashes involving motor vehicles and by helmet type	• Prospective case-control • Data collected from emergency departments of seven Seattle hospitals
Ossenbruggen et al, 2001 (United States)[38]	To use logistic regression models to identify factors that predict the probabilities of crashes and injury	• Logistic regression analysis • Data collected from police accident reports
Bunn et al, 2003 (United Kingdom)[39]	To assess whether area-wide traffic calming schemes can reduce road crash-related deaths and injuries	Systematic review and meta-analysis of randomized controlled trials and controlled before-after studies

nied by educational campaigns to increase public awareness.[22] Also, a review of evidence-based traffic engineering measures revealed that physical barriers, such as fences or dividers, are effective in reducing pedestrian-motor vehicle crashes.[37] These act to prevent midblock crossing and channel pedestrians to safe crossing areas.[37] During this period of increased traffic, governments must understand the need to allocate resources for creating sidewalks or barricades to protect this most vulnerable group.[22]

Cross-Cutting Interventions

Cross-cutting interventions aim to protect all road users. Some interventions limit vehicle speed through various traffic calming measures. Speed can be restricted by placing speed bumps or rumble strips at high-frequency crash sites or by enforcing posted speed limits.[23] In industrialized nations, speed limits are enforced by police, but in low-income countries, this is difficult due to resource constraints. For example, the police force in Ghana is comprised of nearly 16,500 officers

Study Population	Intervention	Outcomes Measured	Key Study Results
Front-seat motor vehicle occupants	Seat belts	Risk of death for shoulder plus lap belt	Manual shoulder plus lap belt reduced risk of death by 73% (OR, 0.27; 95% CI, 0.16–0.46) and automatic shoulder plus lap belt reduced risk of death by 86% (OR, 0.14; 95% CI, 0.07–0.26)
Front-seat passenger car occupants	Seat belts	Death within 30 days of crash	Seat belts reduced relative risk of death by 61% (RR=0.39; 95% CI, 0.37–0.41)
Motorcycle crash driver/passenger pairs	Motorcycle helmets	Death within 30 days of crash	Motorcycle helmets reduced relative risk of death by 39% (RR=0.61; 95% CI, 0.54–0.7)
Motorcycle crash victims	Motorcycle helmets	Head injury	Unhelmeted riders were almost three times more likely to be hospitalized with head injury (RR=2.9; 95% CI, 2.0–4.4) and nearly four times more likely to have severe head injury than helmeted riders (RR=3.7; 95% CI, 1.9–7.3)
Bicycle crash victims	Bicycle helmets	Head and brain injury	Helmets reduced head injury by 69% (OR, 0.31; 95% CI, 0.26–0.37) and brain injury by 65% (OR, 0.35; 95% CI, 0.25–0.48)
	1. Sidewalks 2. Efficient land use	Pedestrian-motor vehicle crashes	1. Crash probability is twice as likely at a site without a sidewalk than a site with one 2. Multipurpose land-use zones had fewer crashes than single-purpose land-use zones
Studies were conducted in Germany, Netherlands, Australia and the United Kingdom	Area-wide traffic calming schemes	Road traffic injuries	Sixteen studies found an 11% reduction in road traffic injuries (pooled rate ratio 0.89; 95% CI, 0.8–1.0)

who are assigned only 145 vehicles for a country with over 18 million inhabitants.[22] This number of vehicles is totally inadequate to properly enforce almost any policy, be it seat belt use or drunk driving. Speed bumps or rumble strips are therefore a viable option for poor countries because they are highly cost-effective and simple to install.[11] These are also particularly well suited for protecting residents who live near rural intercity highways.[11] A systematic review of controlled before-after studies has shown an 11% reduction in RTIs due to traffic calming techniques, such as speed bumps, mini-roundabouts and road narrowing.[39] These interventions have the potential to reduce RTIs and fatalities in less developed countries.[39]

Cross-cutting interventions also include measures to reduce the effects of alcohol on road users. Sobriety checkpoints, lower BAC and minimum drinking age laws in HICs have reduced alcohol-related crashes, injuries/fatalities and extent of impaired driving.[22] However, the transferability of these interventions to less developed nations—particularly those that are very poor—is unknown.[22] As alcohol is a primary risk factor for RTIs, developing nations could begin by establishing the prevalence of drinking and driving.[5] This could be done through random roadside surveys using breathalyzers and testing for blood alcohol among fatally injured drivers.[5] Once prevalence has been established, targeted interventions and rational policies could be developed.[40]

Additional Options

Interventions that limit exposure to risk, such as building regulated mass transit systems, improving efficient land use, restricting motor vehicles and providing shorter routes for cyclists and pedestrians, should also be explored.[1] The latter measure is extremely important for reducing risk to pedestrians who typically cross through traffic rather than use pedestrian bridges that have long stairways and are inconveniently located.[41,42] These interventions have been effective in developed countries, and their use in developing nations should be encouraged whenever possible.[1] A combination of these measures has the potential to allow for increased safe mobility, promote the health benefits of walking and cycling, and decrease levels of air pollution.[1]

Barriers to Implementation and Effectiveness

Intervention plans can fail to be effective due to a host of potential obstacles. Barriers can be social, such as helmets not being "cool" or being too hot or uncomfortable.[22] Reasons frequently cited for nonuse in Indonesia were laziness, physical discomfort and lack of police to enforce use.[29] Token compliance with laws is also a barrier to effectiveness. Helmet use in Indonesia was seen primarily as a law enforcement issue and not one of safety, hence the high rates of riders wearing their helmets unfastened.[29] Low literacy also hinders education efforts, such as those to promote safe bicycle or motorcycle riding, using seat belts or safer crossing behaviors.[22]

Barriers can also be due to cultural beliefs. In many countries, injuries are still thought to be acts of God, and victims can be blamed for their injury, which is summed up by the Ghanaian saying: "The dead is always guilty".[23] The fact that road traffic crashes are still referred to as "accidents" gives the impression that these are random and unpredictable events.[3] The worldviews of various cultures can impede efforts to promote a rational systems approach to road safety. The western worldview is based on the belief that events are preventable and one is in control of one's life.[43] This perspective is at odds with religions and cultures that have a strong sense of predestiny and fate.[43] Traditional health-promotion efforts may not be effective if factors leading to traffic crashes are thought to be outside of one's locus of control.[43]

Poverty, in all countries, represents a major barrier to intervention implementation. National economic situations prevent many countries from adequately addressing any health problem, with traffic safety being no exception.[22] More obvious and pressing health issues, such as HIV/AIDS and other infectious diseases, consume large portions of health budgets in developing countries so that RTIs are not considered a priority.[22] Lack of resources for proper law enforcement is a considerable barrier to improving road safety in less developed nations. In addition to education and engineering strategies, developed countries have relied upon enforcement of laws to reduce RTIs and fatalities.[11,36] Corruption also severely undermines the effectiveness of law enforcement by allowing infractions to go unpunished, thus leading to the perception that traffic laws are "toothless".[44] According to Nantulya and Muli-Musiime, pervasive corruption is a social determinant of road traffic crashes in Kenya, where bribery is said to be "regrettable but widespread".[44] Risk compensation may limit overall effectiveness of interventions. It has been argued that safety measures can increase risky behavior because individuals feel more protected.[45] This is especially applicable to helmet and seat belt laws, which can improve the safety of the compliant individual but raise the risk for others due to increased unsafe driving behaviors.[45] Lastly, lack of political will may be the most important barrier. Without the commitment of governments, little action will be taken.[3]

CURRENT INTERVENTIONS: SUCCESS STORIES

Despite the bleak outlook, there are examples of effective measures being taken to reduce mortality and morbidity from RTIs in less developed countries. A low-income country that has implemented an effective intervention to decrease speeding and resulting crashes is Ghana. Rumble strips were installed at intervals at the Suhum Junction, a frequent crash site on the Accra-Kumasi highway. This simple intervention contributed to a decrease in crashes of 35% and fatalities by 55% in a 16-month period. The total cost of the installation was less than $21,000, a bargain when compared to estimates of $104,610 to redesign the junction or $184,600 to construct a walkway and guardrails to separate pedestrians.[11]

Another successful program has been conducted in Colombia, a middle-income country, which saw a 50% drop in traffic fatalities from 1995 to 2002 as a result of a series of interventions implemented at national and local levels.[1] In 1995, the Traffic Accident Mandatory Insurance Law was introduced, requiring all vehicles to have insurance policies. A levy on insurance generates revenue to fund mass media prevention campaigns, road safety education and support of other activities carried out by state road safety entities. This law also guarantees that the insurer pays for any hospital care received by victims of traffic crashes and has led to improvements in the recording of information on road traffic crashes. The Ministry of Transportation (MoT) also has several initiatives, including a national road safety plan, which will be used to provide policy frameworks and issue general guidelines to local authorities. Another is a national monitoring system, which would allow authorities to track vehicle locations via geographic sensing devices installed in public transport vehicles.

In Bogotá, several policies have been implemented to mandate that all drinking establishments close by 1:00 a.m., to restrict driving in the city during certain hours two days each week and to restrict private vehicles in the city. Last has been the introduction of Bogotá's mass transit system, which transports an average of 800,000 people per day. It has improved mobility in the city in addition to reducing the number of injuries along its routes by building infrastructure that ensures the safety of pedestrians and other road users. The drivers are under contract, and their salaries are established by law. This differs from most public transportation systems where drivers are paid based on the fares they collect—a situation that leads to vehicles being massively overloaded with passengers and driven at high speeds to reach new passengers before the competition.[1,18]

Conclusion and the Way Forward

Much remains to be done to reduce mortality and morbidity associated with road traffic crashes in developing countries. Many are just beginning to take action and programs are in their infancy. Others have still not recognized the true extent of the problem; deaths and injuries will continue to rise in those countries. The adoption of a systems approach to road safety is crucial to stemming the loss of life. However, it is presumptuous to assume an intervention designed in the west will be effective in a less developed country without first understanding the local context and unique social determinants. Research is needed to further uncover factors that distinguish road traffic crashes from those occurring in developed countries. Information gathered can be used to develop novel interventions as well as identify ways to adapt western interventions to meet local needs. Indigenous solutions should be sought and encouraged to promote sustainability and decrease reliance upon international "experts". These actions will also increase community participation and can foster a sense of ownership, thus improving the likelihood of success and compliance. In addition, rigorous evaluation is desperately needed to determine effectiveness of programs and transferability of interventions to less developed countries as well as prevent the wasteful use of scarce resources. Regulating informal public transportation systems and enforcing safety legislation could go a long way in reducing the burden of RTIs. It is imperative that governments of developing countries make this issue a top priority alongside HIV/AIDS and other pressing public health problems. Public investment and funding for road safety must be increased—both by governments and donors—to curb the substantial loss of human capital. The time for action has come.

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